CLAIMS

1. Apparatus for controlling the rate of flow of fluid material through a flow channel having an exit aperture leading to a mold cavity, the apparatus comprising:

a pin having an axis slidably mounted in a housing containing the channel for back and forth axial movement of the pin through the channel;

the pin having a bulbous protrusion along its axis, the bulbous protrusion having a smooth curvilinear surface extending between an upstream end and downstream end of the bulbous protrusion and a maximum diameter circumferential surface intermediate the upstream and downstream ends of the bulbous protrusion;

the channel having an interior surface area portion which is complementary to the maximum diameter circumferential surface of the bulbous protrusion of the pin;

the pin being slidable to a position within the channel such that the maximum diameter circumferential surface of the bulbous protrusion fits in or mates with the complementary interior surface portion of the channel.

2. The apparatus of claim 1 wherein the valve is drivable through at least a first position wherein polymer fluid flow is stopped when the maximum diameter circumferential surface of the bulbous protrusion mates with the complementary interior channel surface and a second downstream or upstream position where polymer fluid flow is enabled between the curvilinear surface of the bulbous protrusion and an interior surface of the channel.

3. The apparatus of claim 2 wherein the valve is drivable through a third downstream position where a terminal downstream end of the valve pin mates with a complementary exit aperture surface to stop fluid flow.

4. The apparatus of claim 1 wherein the maximum diameter circumferential surface of the bulbous protrusion is cylindrical in shape.

5. The apparatus of claim 1 wherein the complementary interior surface portion of the channel is cylindrical in shape.

6. The apparatus of claim 1 wherein the pin is slidably mounted in the housing in an aperture having a diameter equal to or greater than the maximum diameter circumferential surface of the bulbous protrusion of the pin.

7. In an injection molding machine having at least one nozzle for delivering melt material from a manifold to a mold cavity, apparatus for controlling delivery of the melt material from the nozzle to the mold cavity, the nozzle having an exit aperture communicating with a gate of the cavity of the mold and being associated with an actuator interconnected to a melt flow controller, the apparatus comprising:

a sensor for sensing a selected condition of the melt material through the nozzle;

an actuator controller interconnected to the actuator, the actuator controller comprising a computer interconnected to a sensor for receiving a signal representative of the selected condition sensed by the sensor, the computer including an algorithm utilizing a value corresponding to a signal received from the sensor as a variable for controlling operation of the actuator;

wherein the actuator is interconnected to and controls movement of a pin having a bulbous protrusion, the pin and the bulbous protrusion having a common axis, the pin being slidably mounted in a channel leading to the gate for back and forth movement axial movement of the bulbous protrusion through the channel;

wherein the bulbous protrusion has a maximum cross-sectional diameter section having an exterior surface which is matable with a complementary interior wall surface section of the channel at a selected position along the back and forth axial movement of the bulbous protrusion through the channel.

8. Apparatus of claim 7 wherein the at least one nozzle has a seal surface on a tip end of the nozzle, the nozzle being expandable upon heating to a predetermined operating temperature, the nozzle being mounted relative to a complementary surface surrounding the gate such that the seal surface disposed on the tip end of the nozzle is moved into compressed contact with the complementary surface surrounding the gate upon heating of the nozzle to the predetermined operating temperature.

9. Apparatus of claim 7 wherein the tip end of the nozzle comprises an outer unitary piece formed of a first material and an inner unitary piece formed of a second material, the first material being substantially less heat conductive than the second material.

10. Apparatus of claim 7 wherein the sensor comprises a pressure transducer interconnected to at least one of the bore of a nozzle or a mold cavity for detecting the pressure of the melt material.

11. Apparatus of claim 7 wherein the actuator controller further comprises a solenoid having a piston controllably movable between selected positions for selectively delivering a pressurized actuator drive fluid to one or the other of at least two chambers of the actuator.

12. Apparatus of claim 7 wherein the exterior surface of the maximum diameter section of the bulbous protrusion forms a gap between the exterior surface of the bulbous protrusion and the complementary surface of the channel upon axial movement of the pin to a position where the exterior surface of the bulbous protrusion and the complementary surface of

the channel are not mated, wherein the size of the gap is increased when the valve pin is retracted away from the gate and decreased when the valve pin is displaced toward the gate.

13. Apparatus of claim 7 wherein the exterior surface of the maximum diameter section of the bulbous protrusion forms a gap between the exterior surface of the bulbous protrusion and the complementary surface of the channel upon axial movement of the pin to a position where the exterior surface of the bulbous protrusion and the complementary surface of the channel are not mated, wherein the size of the gap is decreased when the valve pin is retracted away from the gate and increased when the valve pin is displaced toward the gate.

14. Apparatus of claim 7 wherein at least one of the valves has a bore and a valve pin, the apparatus further comprising a plug mounted in a recess of the manifold opposite a side of the manifold where the at least one nozzle is coupled, the plug having a bore through which a stem of the valve pin of the nozzle passes, the valve pin having a head, the bore of the plug through which the stem passes having a smaller diameter than the valve pin head at the valve pin head's largest point and the recess of the manifold having a larger diameter than the diameter of the valve pin head at the valve pin head's largest point, so that the valve pin can be removed from the manifold from a side of the manifold in which the recess is formed when the plug is removed from the manifold.

15. Apparatus of claim 7 further comprising a second sensor for sensing a second selected condition of the melt material through a second nozzle, the computer being interconnected to the second sensor for receiving a signal representative of the selected condition sensed by the second sensor, the computer including an algorithm utilizing a value corresponding to a signal received from the second sensor as a variable for controlling operation of an actuator for the second nozzle.

16. Apparatus of claim 7 wherein the seal surface of the at least one nozzle is a radially disposed surface which makes compressed contact with the complementary surface of the mold surrounding the gate.

17. Apparatus of claim 7 wherein the seal surface of the at least one nozzle is a longitudinally disposed tip end surface which makes compressed contact with the complementary surface of the mold surrounding the gate.

18. Apparatus of claim 7 wherein the sensor is selected from the group consisting of a pressure transducer, a load cell, a valve pin position sensor, a temperature sensor, a flow meter and a barrel screw position sensor.

19. Apparatus of claim 7 wherein the pin is mounted in an aperture in a housing containing the channel, the aperture having a diameter equal to or greater than the maximum diameter circumferential surface of the bulbous protrusion of the pin.